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(54) Titre : TURBINE DE POMPE
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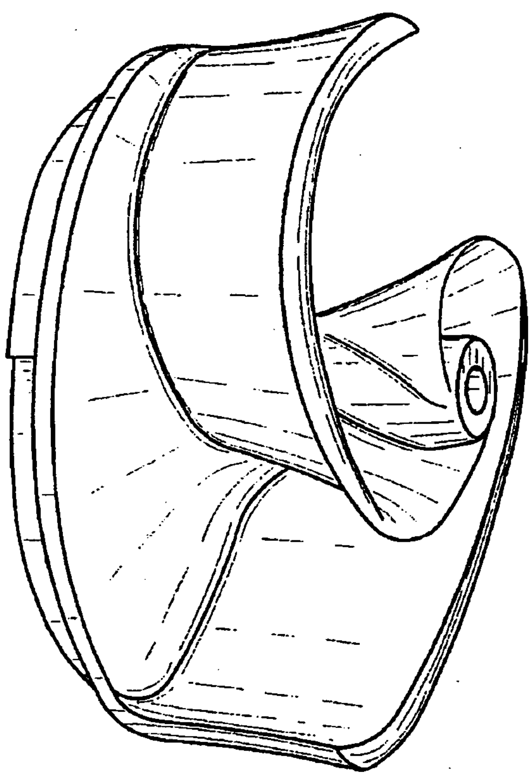

(57) Abrégé/Abstract:
The invention concerns a pump impeller of a centrifugal- or a half axial type meant to pump liquids, mainly sewage water. According to the invention, the pump impeller comprises a hub (4) provided with one or several vanes (5) the leading edges (6) of which being strongly swept backwards. The periphery (8) of the leading edge is displaced 125-195 degrees relative to its connection (7) to the hub (4).

U Arbeus -20

A PUMP IMPELLER

ABSTRACT

The invention concerns a pump impeller of a centrifugal- or a half axial type meant to pump liquids, mainly sewage water.
According to the invention, the pump impeller comprises a hub (4) provided with one or several vanes (5) the leading edges (6) of which being strongly swept backwards . The periphery (8) of the leading edge is displaced 125-195 degrees relative to its connection (7) to the hub (4).

U Arbeus -20

A PUMP IMPELLER

The invention concerns a pump impeller and more precisely a pump impeller for centrifugal-or half axial pumps for pumping of fluids, mainly sewage water.

In literature there are lot of types of pumps and pump impellers for this purpose described, all however having certain disadvantages. Above all this concerns problems with clogging and low efficiency.

Sewage water contains a lot of different types of pollutants, the amount and structure of which depend on the season and type of area from which the water emanates. In cities plastic material, hygiene articles, textile etc are common, while industrial areas may produce wearing particles. Experience shows that the worst problems are rags and the like which stick to the leading edges of the vanes and become wound around the impeller hub. Such incidents cause frequent service intervals and a reduced efficiency.

In agriculture and pulp industry different kinds of special pumps are used, which should manage straw, grass, leaves and other types of organic material. For this purpose the leading edges of the vanes are swept backwards in order to cause the pollutants to be fed outwards to the periphery instead of getting stuck to the edges. Different types of disintegration means are often used for cutting the material and making the flow more easy. Examples are shown in SE-435 952, SE-375 831 and US- 4 347 035.

As pollutants in sewage water are of other types more difficult to master and as the operation times for sewage water pumps normally are much longer, the above mentioned special pumps do not fullfil the requirements when pumping sewage water, neither from a reliability nor from an efficiency point of view.

A sewage water pump quite often operates up to 12 hours a day which means that the energy consumption depends a lot on the total efficiency of the pump.

Tests have proven that it is possible to improve efficiency by up to 50 % for a sewage pump according to the invention as compared with known sewage pumps. As the life cycle cost for an electrically driven pump normally is totally dominated by the energy cost (c:a 80 %), it is evident that such a dramatic increase will be extremely important.

In literature the designs of the pump impellers are described very generally, especially as regards the sweep of the leading edges. An unambigous definition of said sweep does not exist.

Tests have shown that the design of the sweep angle distribution on the leading edges is very important in order to obtain the necessary self cleaning ability of the pump impeller. The nature of the pollutants also calls for different sweep angles in order to provide a good function.

Literature does not give any information about what is needed in order to obtain a gliding, transport, of pollutants outwards in a radial direction along the leading edges of the vanes. What is mentioned is in general that the edges shall be obtuse-angled, swept backwards etc. See SE-435 952.

When smaller pollutantans such as grass and other organic material are pumped, relatively small angles may be sufficient in order to obtain the radial transport and also to disintigrate the pollutants in the slot between pump impeller and the surrounding housing. In practice disintigration is obtained by the particles being cut through contact with the impeller and the housing when the former rotates having a periphery velocity of 10 to 25 m/s. This cutting process is improved by the surfaces being provided with cutting devices, slots or the like. Compare SE-435 952. Such pumps are used for transport of pulp, manure etc.

When designing a pump impeller having vane leading edges swept backwards in order to obtain a self cleaning, a conflict arises between the distribution of the sweep angle, performance and other design parameters. In general it is true that an increased sweep angle means a less risk for clogging, but at the same time the efficiency decreases.

The invention brings about a possibility to design the leading edge of the vane in an optimum way as regards obtaining of the different functions and qualities for reliable and economic pumping of sewage water containing pollutants such as rags, fibres etc.

In accordance with the present invention, there is provided a pump impeller of a centrifugal or half axial type, the pump impeller used in a pump that pumps sewage water, the pump having a generally spiral formed pump housing (1) with a cylindric inlet (2), the pump impeller comprising: a periphery defining a first diameter; a hub (4) defining a second diameter; and at least one vane (5) having a backwards swept leading edge (6) with a first connection (7) to the hub (4) at the second diameter thereof and a second connection (8) to the periphery at the first diameter thereof, the leading edge (6) swept at a sector angle $\Delta\theta$ ranging between 125 degrees and 195 degrees as measured in a coordinate system with an origin in a center of the hub, the sector angle $\Delta\theta$ defined between the first connection (7) and the second connection (8).

The invention is described more closely below with reference to the enclosed drawings.

Fig 1 shows a three dimensional view of a pump impeller according to the invention, Fig 2 shows a radial cut through a schematically drawn pump according to the

invention, while Fig 3 shows a schematic axial view of the inlet to the impeller and Fig 4 a diagram showing the angle distribution of the vane leading edge as a function of a standardized radius.

In the drawings 1 stands for centrifugal pump housing having a cylindric inlet 2. 3 stands for a pump impeller with a cylindric hub 4 and a vane 5. 6 stands for the leading edge of the vane having a connection 7 to the hub and a periphery 8. 9 stands for the slot between the vane and the pump housing wall and 10 the trailing edge of the vane. 11 stands for direction of rotation and 12 the end of the hub. $\Delta\theta$ finally stands for the sector angle between the connection 7 of the leading edge to the hub and the periphery 8 of the leading edge.

As previously mentioned it is an advantage to design the leading edges 6 of the vanes swept backwards in order to make sure that pollutants slide towards the periphery instead of becoming stuck to the edges or being wound around the hub 4.

At the same time however, the efficiency quite often decreases when the sweep angle is increased.

According to the invention the vane 6 is designed with its leading edge 7 being strongly swept backwards. This is defined as the angle difference $\Delta\theta$ in a cylinder coordinate system between the conneection of the leading edge to the hub 4 and the periphery 8. According to the invention said difference shall be between 125 and 195 degrees, preferably 140 to 180 degrees. This is possible, without loosing the possibility of a good efficiency, thanks to the fact that the leading edge 6 is located within the cylindric part 2 of the pump housing.

In order to make this location of the leading edge 6 possible, the impeller hub 4 is designed narrow. The diameter ratio between the connection 7 of the leading edge to the hub and the periphery 8 being only 0.1 to 0.4, preferably 0.15 to 0.35. This small ratio also having the advantage that the free throughlet through the impeller being wide, thus making it possible for larger pollutants to pass.

According to a preferred embodiment of the invention, the connection 7 to the hub 4 of the leading edge 6 being located adjacent the end 12 of the hub, i. e. that there is no protruding tip, which diminishes the risk for pollutants being wound around the central part of the impeller.

According to still another preferred embodiment of the invention, the leading edge 6 is located in a plane perpendicular to the impeller shaft, i. e. where z is constant. This means that the sweep angle will be essentially constant, independant of the flow. As sewage pumps operate within a very broad field this means that the pump impeller can be designed at its optimum and being independant of expected operation conditions.

CLAIMS:

1. A pump impeller of a centrifugal or half axial type, the pump impeller used in a pump that pumps sewage water, the pump having a generally spiral formed pump housing (1) with a cylindric inlet (2), the pump impeller comprising:

a periphery defining a first diameter;

a hub (4) defining a second diameter; and

at least one vane (5) having a backwards swept leading edge (6) with a first connection (7) to the hub (4) at the second diameter thereof and a second connection (8) to the periphery at the first diameter thereof, the leading edge (6) swept at a sector angle $\Delta\theta$ ranging between 125 degrees and 195 degrees as measured in a coordinate system with an origin in a center of the hub, the sector angle $\Delta\theta$ defined between the first connection (7) and the second connection (8).

2. A pump impeller according to claim 1, wherein the leading edge (6) of the at least one vane (5) lies in a plane perpendicular to the hub.

3. A pump impeller according to claim 1, wherein the connection (7) of the leading edge (6) to the hub (4) is located adjacent an end (12) of the hub.

4. A pump impeller according to claim 1, wherein the second diameter of the hub (4) and the first diameter of the periphery define a diameter ratio ranging between 0.1 and 0.4.

5. A pump impeller according to claim 1, wherein the second diameter of the hub (4) and the first diameter of the

periphery define a diameter ratio ranging between 0.15 to 0.35.

6. A pump impeller according to claim 1, wherein the sector angle $\Delta\theta$ ranges between 140-180 degrees.

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PATENT AGENTS

FIG. 1

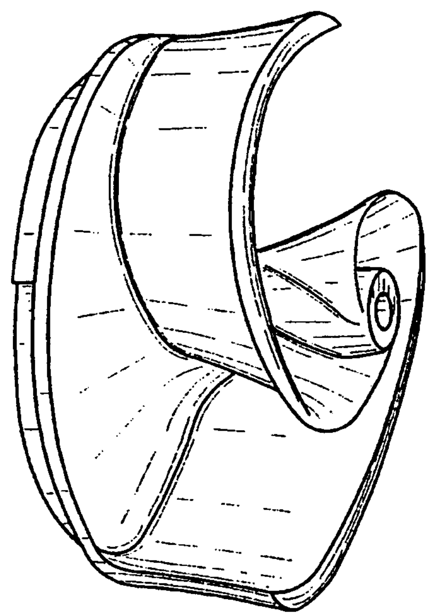


FIG. 2

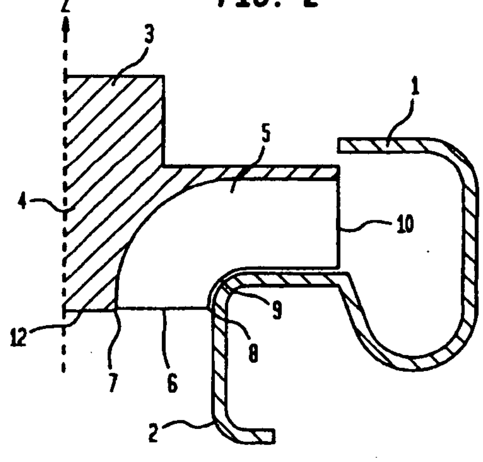


FIG. 3

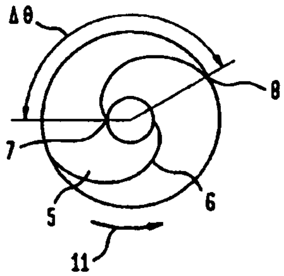
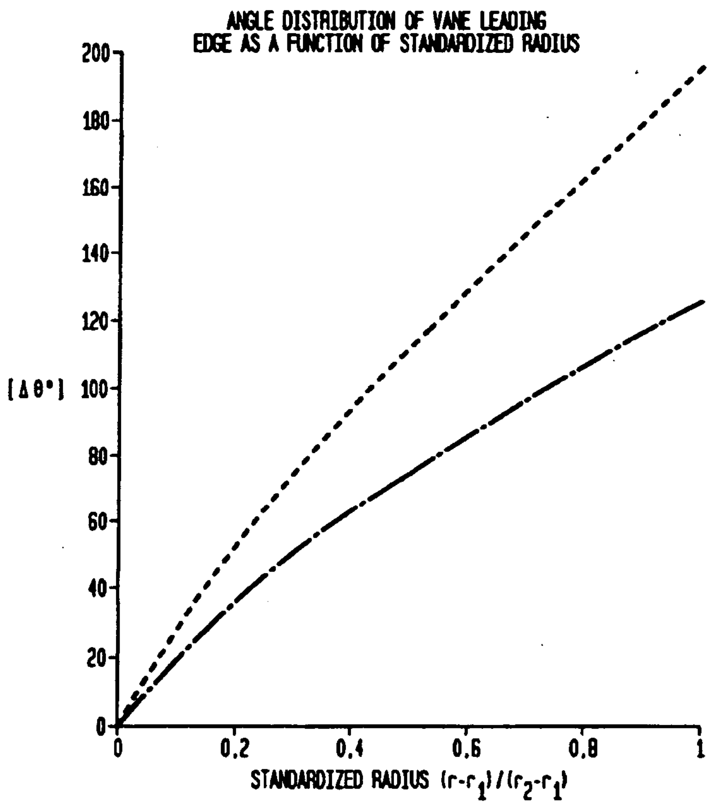

Δθ
8
7
6
5
11

FIG. 4


ANGLE DISTRIBUTION OF VANE LEADING EDGE AS A FUNCTION OF STANDARDIZED RADIUS
200
180
160
140
120
[Δθ°] 100
80
60
40
20
0
0
0,2
0,4
0,6
0,8
1
STANDARDIZED RADIUS (r-r1)/(r2-r1)